CLAIMS

We claim:

[c1] 1. A method of forming a conductive interconnect in a microelectronic device, the method comprising:

providing a microfeature workpiece having a plurality of dies;

forming a passage extending through the microfeature workpiece from a first side of the microfeature workpiece to an opposite second side of the microfeature workpiece;

forming a conductive plug in the passage adjacent to the first side of the microelectronic workpiece; and

depositing conductive material in the passage to at least generally fill the passage from the conductive plug to the second side of the microelectronic workpiece.

[c2] 2. The method of claim 1 wherein forming a conductive plug includes depositing an electrically conductive material in the passage using a maskless mesoscale materials deposition process.

[c3] 3. The method of claim 1 wherein forming a conductive plug includes applying an electronic ink in the passage using an electronic printing process.

[c4] 4. The method of claim 1 wherein forming a conductive plug includes depositing an electrically conductive material in the passage using a nano-particle deposition process.

[c5] 5. The method of claim 1 wherein forming a conductive plug includes depositing silver in the passage.

[c6] 6. The method of claim 1, further comprising forming a bond-pad on the microelectronic workpiece, wherein forming the passage includes forming the passage through the bond-pad, and wherein forming a conductive plug in the passage includes depositing a conductive material to contact an exposed surface of the bond-pad.

[c7] 7. The method of claim 1 wherein forming the passage includes laser drilling the passage through the die.

[c8] 8. The method of claim 1 wherein providing a microfeature workpiece includes providing a die having an integrated circuit and a bond-pad electrically coupled to the integrated circuit, and wherein forming the passage includes laser drilling the passage through the die and the bond pad.

[c9] 9. The method of claim 1, further comprising applying a passivation layer to at least a portion of the passage before forming the conductive plug in the passage and filling the passage from the conductive plug to the second side of the microelectronic workpiece.

[c10] 10. The method of claim 1, further comprising forming a bond-pad on the microelectronic workpiece in contact with the conductive plug.

[c11] 11. The method of claim 1 wherein depositing conductive material in the passage to at least generally fill the passage includes biasing the conductive plug at an electrical potential.

[c12] 12. The method of claim 1, further comprising forming a metallic layer on the first side of the microelectronic workpiece in contact with the conductive plug.

[c13] 13. The method of claim 1, further comprising forming a metallic layer on the first side of the microelectronic workpiece in contact with the conductive plug, wherein depositing conductive material in the passage to at least generally fill the passage includes biasing the metallic layer at an electrical potential.

[c14] 14. The method of claim 1 wherein forming a conductive plug includes depositing an electrically conductive material in the passage using solder tent technology.

[c15] 15. A method of forming a conductive interconnect in a microelectronic device, the method comprising:

providing a microfeature workpiece having a plurality of dies and at least one passage of the microfeature workpiece extending through the microfeature workpiece from a first side to an opposing second side of the microfeature workpiece, the passage defining a first opening in the first side of the microfeature workpiece and a second opening in the second side of the microfeature workpiece;

applying a sealing layer to the first side of the microfeature workpiece to at least generally seal the first opening of the passage; and

depositing a portion of conductive material through the second opening of the passage to at least partially fill the passage.

[c16] 16. The method of claim 15 wherein depositing a portion of conductive material through the second opening of the passage includes forming a plug in the passage adjacent to the sealing layer.

[c17] 17. The method of claim 15 wherein depositing a portion of conductive material through the second opening of the passage includes depositing a first portion of conductive material to form a conductive plug in the passage adjacent to the sealing layer, and further comprising depositing a second portion of

conductive material through the second opening of the passage, the second portion of conductive material at least generally filling the passage from the conductive plug to the second side of the microelectronic workpiece.

[c18] 18. The method of claim 15 wherein depositing a portion of conductive material through the second opening of the passage includes depositing a first portion of conductive material to form a conductive plug in the passage adjacent to the sealing layer, and further comprising:

removing the sealing layer from the first side of the microfeature workpiece; and

depositing a second portion of conductive material through the second opening of the passage, the second portion of conductive material at least generally filling the passage from the conductive plug to the second side of the microelectronic workpiece.

[c19] 19. The method of claim 15 wherein depositing a portion of conductive material through the second opening of the passage includes depositing a first portion of conductive material to form a conductive plug in the passage adjacent to the sealing layer, and further comprising:

biasing the plug at an electrical potential; and

electrically depositing a second portion of conductive material through the second opening of the passage, the second portion of conductive material at least generally filling the passage from the conductive plug to the second side of the microelectronic workpiece.

[c20] 20. The method of claim 15 wherein depositing a portion of conductive material through the second opening of the passage includes depositing a first portion of conductive material to form a conductive plug in the passage adjacent to the sealing layer, and further comprising:

removing the sealing layer from the first side of the microfeature workpiece;

biasing the plug at an electrical potential; and

electrically depositing a second portion of conductive material through the second opening of the passage, the second portion of conductive material at least generally filling the passage from the conductive plug to the second side of the microelectronic workpiece.

[c21] 21. The method of claim 15 wherein depositing a portion of conductive material through the second opening of the passage includes depositing a first portion of conductive material to form a conductive plug in the passage adjacent to the sealing layer, and further comprising:

positioning a conductive element adjacent to the first side of the microelectronic workpiece in electrical contact with the plug;

biasing the plug at an electrical potential with the conductive element; and

electrically depositing a second portion of conductive material through the second opening of the passage, the second portion of conductive material at least generally filling the passage from the conductive plug to the second side of the microelectronic workpiece.

[c22] 22. The method of claim 15 wherein depositing a portion of conductive material through the second opening of the passage includes depositing a first portion of conductive material to form a conductive plug in the passage adjacent to the sealing layer, and further comprising:

removing the sealing layer from the first side of the microfeature workpiece;

depositing a conductive layer on the first side of the microfeature workpiece in contact with the plug in the passage;

electrically biasing the conductive layer; and

electrically depositing a second portion of conductive material through the second opening of the passage, the second portion of conductive material at least generally filling the passage from the conductive plug to the second side of the microelectronic workpiece.

[c23] 23. The method of claim 15 wherein depositing a portion of conductive material through the second opening of the passage includes depositing a first portion of conductive material to form a conductive plug in the passage adjacent to the sealing layer, and further comprising:

depositing a second portion of conductive material through the second opening of the passage, the second portion of conductive material at least generally filling the passage from the conductive plug to the second side of the microelectronic workpiece; and

forming a bond-pad electrically coupled to the conductive plug.

[c24] 24. A method of forming a conductive interconnect in a microelectronic device, the method comprising:

providing a microfeature workpiece having a plurality of dies and at least one passage, the passage extending through the microfeature workpiece from a first side to an opposing second side, the passage defining a first opening in the first side of the microfeature workpiece and a second opening in the second side of the microfeature workpiece;

positioning a contact surface in contact with the first side of the microelectronic workpiece, the contact surface at least generally covering the first opening of the passage; and

depositing conductive material through the second opening of the passage to at least partially fill the passage from the contact surface toward the second side of the microfeature workpiece.

[c25] 25. The method of claim 24 wherein depositing conductive material through the second opening of the passage includes at least generally filling the passage with the conductive material from the contact surface to the second side of the microelectronic workpiece.

[c26] 26. The method of claim 24 wherein depositing conductive material through the second opening of the passage includes forming a plug in the passage in contact with the contact surface.

[c27] 27. The method of claim 24 wherein positioning a contact surface includes positioning a conductive contact surface, and further comprising biasing the conductive contact surface at an electrical potential, wherein depositing conductive material through the second opening of the microfeature workpiece includes electrically depositing conductive material onto the electrically biased conductive contact surface.

[c28] 28. A packaged microelectronic device comprising:

a die having a first side and a second side opposite to the first side, the die further having an integrated circuit positioned between the first and second sides;

a bond-pad positioned on the first side of the die and electrically coupled to the integrated circuit;

a passage extending completely through the die and aligned with the bond-pad;

a first conductive material deposited in a first portion of the passage adjacent to the first side of the die to form a conductive plug electrically connected to the bond-pad; and

a second conductive material deposited in a second portion of the passage in contact with the conductive plug to at least generally fill the passage from the conductive plug to the second side of the die.

[c29] 29. The packaged microelectronic device of claim 28, further comprising an insulative layer deposited in the passage between the die and the first and second conductive materials.

[c30] 30. The packaged microelectronic device of claim 28 wherein the passage extends through the bond-pad, and further comprising an insulative layer deposited in the passage between the die and the first and second conductive materials.

[c31] 31. The packaged microelectonic device of claim 28 wherein the passage extends through the bond-pad, and wherein the first conductive material includes an electronic ink in contact with an exposed surface of the bond pad.

[c32] 32. The packaged microelectonic device of claim 28 wherein the passage extends through the bond-pad, and wherein the first conductive material includes a nano-particle deposition in contact with an exposed surface of the bond pad.

[c33] 33. A microfeature workpiece having a first side and a second side opposite to the first side, the microfeature workpiece comprising:

at least one die;

a passage extending completely through the die from the first side of the microfeature workpiece to the second side of the microfeature workpiece;

a first conductive material deposited in a first portion of the passage adjacent to the first side of the microfeature workpiece to form a conductive plug; and

a second conductive material deposited in a second portion of the passage in contact with the conductive plug to at least generally fill the passage from the conductive plug to the second side of the microfeature workpiece.

[c34] 34. The microfeature workpiece of claim 33 wherein the first conductive material includes an electronic ink.

[c35] 35. The microfeature workpiece of claim 33 wherein the first conductive material includes a nano-particle deposition.

[c36] 36. The microfeature workpiece of claim 33, further comprising an insulative layer deposited in the passage between the first and second conductive materials.

[c37] 37. The microfeature workpiece of claim 33, further comprising a metallic layer formed on the first side of the microfeature workpiece.

[c38] 38. The microfeature workpiece of claim 33, further comprising a bond-pad formed on the first side of the microfeature workpiece in contact with the conductive plug.

[c39] 39. A microelectronic device set comprising:

a first microelectronic device having:

a first die with a first integrated circuit and a first bond-pad electrically coupled to the first integrated circuit, the first die further including a passage extending completely through the first die and the first bond-pad; and

a conductive interconnect deposited in the passage, the conductive interconnect including a first conductive material deposited in a first portion of the passage to form a conductive plug, and a second conductive material deposited in a second portion of the passage in contact with the conductive plug to at least generally fill the passage; and

at least a second microelectronic device having a second die with a second integrated circuit and a second bond-pad electrically coupled to the second integrated circuit, wherein the second bond-pad is

electrically coupled to the conductive interconnect of the first microelectronic device.

[c40] 40. The microelectronic device set of claim 39 wherein the first microelectronic device is attached to the second microelectronic device in a stacked-die arrangement.

[c41] 41. The microelectronic device set of claim 39, further comprising a solder ball disposed between the conductive interconnect of the first microelectronic device and the second bond-pad of the second microelectronic device to electrically couple the first bond-pad to the second bond-pad.

[c42] 42. The microelectronic device set of claim 39 wherein the passage is a first passage, wherein the second microelectronic device further includes a second passage extending through the second die and the second bond-pad, and wherein the second passage is completely filled with a third conductive material.

[c43] 43. The microelectronic device set of claim 39 wherein the first microelectronic device further includes a redistribution layer formed on the first die, the redistribution layer including a conductive line having a first end portion attached to the first bond-pad and a second end portion positioned outward of the first end portion, wherein the second end portion is configured to receive electrical signals and transmit the signals to at least the first integrated circuit of the first die and the second integrated circuit of the second die.

[c44] 44. A microelectronic device set comprising:

a first microelectronic device having:

a first die with a first integrated circuit and a first bond-pad electrically coupled to the first integrated circuit, the first die

further including a passage aligned with the first bond-pad; and

a conductive interconnect deposited in the passage, the conductive interconnect including a first conductive material deposited in a first portion of the passage to form a conductive plug in contact with the bond-pad, and a second conductive material deposited in a second portion of the passage in contact with the conductive plug to at least generally fill the passage; and

at least a second microelectronic device having a second die with a second integrated circuit and a second bond-pad electrically coupled to the second integrated circuit, wherein the second bond-pad is electrically coupled to the first bond-pad of the first microelectronic device.

[c45] 45. The packaged microelectronic device of claim 44, further comprising an insulative layer deposited in the passage between the first and second conductive materials.

[c46] 46. The packaged microelectronic device of claim 44 wherein the passage extends through the first bond-pad, and wherein the first conductive material includes an electronic ink in contact with an exposed surface of the bond pad.

[c47] 47. The packaged microelectonic device of claim 44 wherein the passage extends through the bond-pad, and wherein the first conductive material includes a nano-particle deposition in contact with an exposed surface of the bond pad.